

What Is Claimed Is:

1 1. A network address forwarding table lookup apparatus for
2 identifying a fixed-length network address to determine a next
3 hop address to which data packets having the network address
4 should be forwarded, the apparatus comprising:
5 a memory storing a compression-trie forwarding table, the
6 forwarding table having a first level module, a second level
7 module, and a third level module;
8 the first level module comprising a first compression
9 bitmap having first level index entries directly addressable by
10 a first field of address bits from the network address of the
11 data packets, and a first level pointer to the second level
12 module, wherein each of the first level index entries
13 alternatively comprises an independent index or a dependent
14 index;
15 the second level module comprising second level primary
16 entries directly addressable by the first level pointer and the
17 first level index entries comprising the independent index, each
18 of the second level primary entries alternatively comprising a
19 next hop index indicating the next hop address for the data
20 packets while the first field of address bits is sufficient to
21 determine the next hop index, or a second level submodule while
22 the first field of address bits is not sufficient to determine
23 the next hop address, wherein the second level submodule
24 comprises a second compression bitmap having second level index
25 entries associatively addressable by a second field of address
26 bits from the network address of the data packets, and a second
27 level pointer to the third level module, wherein each of the

28 second level index entries alternatively comprises the
29 independent index or the dependent index; and

30 the third level module comprising third level primary
31 entries directly addressable by the second level pointer and the
32 second level index entries comprising the independent index,
33 each of the third level primary entries comprising a next hop
34 index indicating the next hop address for the data packets while
35 the first and second fields of address bits are sufficient to
36 determine the next hop index;

37 wherein each of the first level index entries comprising
38 the independent index directly corresponds to one of the second
39 level primary entry, each of the first level index entries
40 comprising the dependent index associatively corresponds to the
41 second level primary entry to which the previous first level
42 index entry comprising the independent index directly
43 corresponds, each of the second level index entries comprising
44 the independent index directly corresponds to one of the third
45 level primary entry, and each of the second level index entries
46 comprising the dependent index associatively corresponds to the
47 third level primary entry to which the previous second level
48 index entry comprising the independent index directly
49 corresponds.

1 2. The network address forwarding table lookup apparatus
2 according to claim 1, wherein:

3 the forwarding table further has a fourth level module;
4 each of the third level primary entries alternatively
5 comprises a third level submodule while the first and second
6 fields of address bits are not sufficient to determine the next
7 hop address, wherein the third level submodule comprises a third

8 compression bitmap having third level index entries
9 associatively addressable by a third field of address bits from
10 the network address of the data packets, and a third level
11 pointer to the fourth level module, wherein each of the third
12 level index entries alternatively comprises the independent
13 index or the dependent index;

14 the fourth level module comprises fourth level primary
15 entries directly addressable by the third level pointer and the
16 third level index entries comprising the independent index, each
17 of the fourth level primary entries comprising a next hop index
18 indicating the next hop address for the data packets while the
19 first, second and third fields of address bits are sufficient
20 to determine the next hop index; and

21 each of the third level index entries comprising the
22 independent index directly corresponds to one of the fourth
23 level primary entry, and each of the third level index entries
24 comprising the dependent index associatively corresponds to the
25 fourth level primary entry to which the previous third level
26 index entry comprising the independent index directly
27 corresponds.

1 3. The network address forwarding table lookup apparatus
2 according to claim 2, wherein:

3 the forwarding table further has a fifth level module;
4 each of the fourth level primary entries alternatively
5 comprises a fourth level submodule while the first, second and
6 third fields of address bits are not sufficient to determine the
7 next hop address, wherein the fourth level submodule comprises
8 a fourth compression bitmap having fourth level index entries
9 associatively addressable by a fourth field of address bits from

10 the network address of the data packets, and a fourth level
11 pointer to the fifth level module, wherein each of the fourth
12 level index entries alternatively comprises the independent
13 index or the dependent index;

14 the fifth level module comprises fifth level primary
15 entries directly addressable by the fourth level pointer and the
16 fourth level index entries comprising the independent index,
17 each of the fifth level primary entries comprising a next hop
18 index indicating the next hop address for the data packets while
19 the first, second, third and fourth fields of address bits are
20 sufficient to determine the next hop index; and

21 each of the fourth level index entries comprising the
22 independent index directly corresponds to one of the fifth level
23 primary entry, and each of the fourth level index entries
24 comprising the dependent index associatively corresponds to the
25 fifth level primary entry to which the previous fourth level
26 index entry comprising the independent index directly
27 corresponds.

1 4. The network address forwarding table lookup apparatus
2 according to claim 3, wherein the network address is an Internet
3 Protocol (IP) address.

1 5. The network address forwarding table lookup apparatus
2 according to claim 1, wherein the independent index is a bit '1',
3 and the dependent index is a bit '0'.

1 6. An IPv4 address forwarding table lookup apparatus for
2 identifying a 32-bit Internet Protocol (IP) address to determine

3 a next hop address to which data packets having the IP address
4 should be forwarded, the apparatus comprising:

5 a memory storing a five-level compression-trie forwarding
6 table, the forwarding table having a first level module, a second
7 level module, a third level module, a fourth level module, and
8 a fifth level module;

9 the first level module comprising a first compression
10 bitmap having two first level index entries directly addressable
11 by the 17th address bit from the IP address of the data packets,
12 and a first level pointer to the second level module, wherein
13 each of the first level index entries alternatively comprises
14 a bit '1' or a bit '0';

15 the second level module comprising second level primary
16 entries directly addressable by the first level pointer and the
17 first level index entries comprising the bit '1', each of the
18 second level primary entries alternatively comprising a next hop
19 index indicating the next hop address for the data packets while
20 the first to the 17th address bits of the IP address sufficient
21 to determine the next hop index, or a second level submodule
22 while the first to the 17th address bits of the IP address are
23 not sufficient to determine the next hop address, wherein the
24 second level submodule comprises a second compression bitmap
25 having 128 second level index entries associatively addressable
26 by the 18th to the 24th address bits from the IP address of the
27 data packets, and a second level pointer to the third level
28 module, wherein each of the second level index entries
29 alternatively comprises the bit '1' or the bit '0';

30 the third level module comprising third level primary
31 entries directly addressable by the second level pointer and the
32 second level index entries comprising the bit '1', each of the

33 third level primary entries alternatively comprising a next hop
34 index indicating the next hop address for the data packets while
35 the first to the 24th address bits of the IP address are
36 sufficient to determine the next hop index, or a third level
37 submodule while the first to the 24th address bits of the IP
38 address are not sufficient to determine the next hop address,
39 wherein the third level submodule comprises a third compression
40 bitmap having two third level index entries associatively
41 addressable by the 25th address bit from the IP address of the
42 data packets, and a third level pointer to the fourth level
43 module, wherein each of the third level index entries
44 alternatively comprises the bit '1' or the bit '0';

45 the fourth level module comprising fourth level primary
46 entries directly addressable by the third level pointer and the
47 third level index entries comprising the bit '1', each of the
48 fourth level primary entries alternatively comprising a next hop
49 index indicating the next hop address for the data packets while
50 the first to the 25th address bits of the IP address are
51 sufficient to determine the next hop index, or a fourth level
52 submodule while the first to the 25th address bits of the IP
53 address are not sufficient to determine the next hop address,
54 wherein the fourth level submodule comprises a fourth
55 compression bitmap having 128 fourth level index entries
56 associatively addressable by the 26th to the 32nd address bits
57 from the IP address of the data packets, and a fourth level
58 pointer to the fifth level module, wherein each of the fourth
59 level index entries alternatively comprises the bit '1' or the
60 bit '0'; and

61 the fifth level module comprising fifth level primary
62 entries directly addressable by the fourth level pointer and the

63 fourth level index entries comprising the bit '1', each of the
64 fifth level primary entries comprising a next hop index
65 indicating the next hop address for the data packets;

66 wherein each of the first, second, third and fourth level
67 index entries comprising the bit '1' directly corresponds to one
68 of the next level primary entry in sequence, and each of the
69 first, second, third and fourth level index entries comprising
70 the bit '0' associatively corresponds to the next level primary
71 entry to which the previous same level index entry comprising
72 the bit '1' directly corresponds.

1 7. A network address forwarding table lookup method for
2 identifying a network address with a compression-trie
3 forwarding table to determine a next hop address to which data
4 packets having the network address should be forwarded, the
5 compression-trie forwarding table having multiple level
6 entries, the method comprising the steps of:

7 retrieving a first field of address bits of the network
8 address, and searching for a bit in the first level entries of
9 the compression-trie forwarding table, wherein the bit directly
10 corresponds to the first field;

11 searching for an indicative entry in the next level entries
12 of the compression-trie forwarding table, wherein the
13 indicative entry associatively corresponds to the bit;

14 obtaining a next hop index indicating the next hop address
15 while the indicative entry comprises the next hop index; and

16 retrieving a next field of address bits of the network
17 address, and searching for a next bit in the indicative entry
18 while the indicative entry does not comprise the next hop index,

Client's ref.: /2001/09/11
File:0706-6544usfrev/Calvin/Kevin

19 wherein the next bit associatively corresponds to the next
20 field.

1 8. The method as claimed in claim 7, wherein the network
2 address is an Internet Protocol (IP) address.